

CLAIMS

What is claimed is:

1. A process for improved performance in at least one fuel cell comprising a cathode, an anode, an anode chamber, a cathode chamber, a liquid comprising an anolyte that flows through the cell, and a catholyte gas,
5 wherein the fuel cell is connected to an external load, and wherein the process comprises:
 - (a1) taking the load off the fuel cell; and
 - (a2) cycling between a minimum voltage and at least about 50% of a
10 maximum voltage drawn from the fuel cell until a maximum current is reached;
or
 - (a3) cycling between a minimum load, and at least about 50% of the maximum load, until a maximum voltage is reached.
2. The process of claim 1 wherein minimum voltage is about 0.1 to
15 about 30% of the maximum voltage
3. The process of claim 1 wherein cycling is between a minimum voltage and about 60 to about 90% of the maximum voltage.
4. The process of claim 1 wherein the fuel cell is a direct feed fuel cell.
5. The process of claim 4 wherein the fuel is in the liquid or vapor
20 phase.
6. The process of claim 5 wherein the fuel is an alcohol or an ether.
7. The process of claim 6 wherein the alcohol is methanol or ethanol.
8. The process of claim 6 wherein the ether is diethyl ether.
9. The process of claim 3 wherein cycling is between a minimum
25 voltage and about 90 to about 100% of the maximum voltage.
10. The process of claim 1 wherein minimum load is about 0 to about 5% of the maximum load.
11. The process of claim 1 wherein cycling is between a minimum load about 60 to about 90% of the maximum load.
- 30 12. The process of claim 11 wherein cycling is between a minimum load and about 90 to about 100% of the maximum load.
13. The process of claim 1 wherein before step (a2) or (a3), the process further comprises:

(b) clearing the fuel cell of any liquid present therein to achieve a resistance of at least about 10% higher than the value before clearing the cell of any liquid; and

(c) starting the flow of anolyte through the fuel cell.

5 14. The process of claim 13 wherein the clearing of the fuel cell of any liquid present therein is achieved by:

(b1) stopping the flow of anolyte through the fuel cell; and

(b2) providing a continuous flow of catholyte gas through the fuel cell for at least 30 seconds;

10 15. The process of claim 13 or 14 further comprising:

(d) oxidizing the residual fuel in the fuel cell.

16. The process of claim 15 wherein oxidizing the residual fuel in the fuel cell is achieved by breaking the electrical connection between the cathode and anode.

15 17. The process of claim 15 wherein oxidizing the residual fuel in the fuel cell is achieved by applying a constant voltage in the range of about 0.005 V to about 0.8 V per cell.

18. The process of claim 13 or 14 wherein before step (c), the anode chamber is purged with air.

20 19. The process of claim 13 or 14 wherein before step (c), the anode chamber is purged with nitrogen.

20. The process of claim 13 or 14 wherein after step (a1) the anode chamber is purged with water.

25 21. The process of claim 15 wherein before step (c) the anode chamber of is purged with air.

22. The process of claim 13 or 14 wherein the before step (c), the cathode chamber is purged with air.

23. The process of claim 18 wherein the cathode chamber is purged with air.

30 24. The process of claim 22 wherein the cathode chamber is purged with air for at least 10 seconds.

25. The process of claim 23 wherein the cathode chamber is purged with air for at least 10 seconds.

26. The process of claim 23 wherein the anode chamber is purged with air after the cathode chamber is purged.

27. The process of claim 23 wherein the anode chamber is purged with nitrogen after the cathode chamber is purged.

5 28. The process of claim 26 wherein the air comprises exhaust air from the cathode chamber.

29. The processes of claim 26 wherein the anode chamber is purged for about 2-15 minutes.

10 30. The processes of claim 27 wherein the anode chamber is purged for about 2-15 minutes.

31. The processes of claim 30 wherein the anode chamber is purged for about 2-15 minutes.

32. The processes of claim 29, 30 or 31 wherein the anode chamber is purged for about 5-15 minutes.

15 33. The processes of claim 32, wherein the anode chamber is purged for about 10-15 minutes.

34. The process of claim 1 wherein the resistance reached is at least about 20% higher than the value before clearing the cell of any liquid.

20 35. The process of claim 34 wherein the resistance reached is about 100 to about 500% higher than the value before clearing the cell of any liquid.

36. The process of claim 1 or 13 wherein fuel cells are in a stack.

37. The process of claim 15 wherein fuel cells are in a stack.